Radical prostatectomy (RP) remains the standard therapy for the treatment of men with localized prostate cancer because it is associated with a clear survival benefit and longer life expectancy. As technology has advanced, many urologists have transitioned away from open RP and have quickly adopted minimally invasive technology to first perform laparoscopic RP and now robotic-assisted laparoscopic RP in attempts to minimize the morbidity associated with this procedure. Although this technology has led to better perioperative outcomes, such as a reduction in hospital length of stay and lower odds of requiring blood transfusions, oncological and functional outcomes such as continence and erectile dysfunction remain similar for surgeons experienced with either approach.1

One aspect of RP that is often variable is a positive surgical margin (PSM) on final pathological examination. Rates of PSMs may change on the basis of certain factors, such as surgical technique (open vs minimally invasive), tumor aggressiveness, and surgeon experience. Some evidence does suggest that PSM rates are lower with robotic-assisted RP vs open RP (13.8% vs 22.8%).2 However, data comparing these 2 modalities are often difficult to interpret because many of these studies are nonstandardized in terms of pathological review, nerve-sparing status, tumor volume, and surgeon experience. Positive surgical margins are often associated with a more-advanced stage or aggressive disease, with rates as high as 60% for pT3 disease.2 However, 1 known modifiable risk factor as a source of potentially avoidable PSMs is the surgeon experience. A multi-institutional study by Bravi et al3 found that for both organ-confined and non–organ-confined disease, surgeons with more experience with robotic-assisted RP had a higher rate of negative margins. When comparing surgeons performing their first 10 operations with those with at least 250 prior operations, the rate of PSMs decreased from 16.7% to 9.6% in organ-confined disease and from 38.4% to 24.9% in non–organ-confined disease.2 Although this finding may speak to the greater need for centralization of care at high-volume centers for these procedures, it is essential to note that biochemical recurrence rates were not found to be different for these surgeons despite their level of experience.3

Management of PSMs after RP remains a clinical challenge because the exact outcome on a patient’s long-term survival is debatable. Although PSMs are associated with biochemical recurrence, adverse pathological features of the disease, such as advanced stage and grade group, are likely associated with more meaningful prostate cancer–specific end points.4 For example, Mithal et al4 retrospectively analyzed more than 4000 men who underwent RP, and those with a PSM were twice as likely to have biochemical recurrence as those without a PSM. However, when controlling for pathological characteristics such as Gleason score, prostate-specific antigen level, and tumor stage, other end points, such as the development of castration resistance, metastatic sites, and cancer-specific mortality, were not associated with PSMs.5 Studies such as this highlight the need for clinicians to consider the entirety of the patient and to stratify risk according to tumor characteristics and clinical scenario before recommending adjuvant therapies after RP with a PSM.

Although the oncological outcome is difficult to determine, PSMs often do lead to adjuvant therapy, specifically radiation therapy (RT). Martini and colleagues5 queried the US National Cancer Database to answer an important question regarding the financial outcomes of a PSM in terms of further treatment for prostate cancer. The authors specifically looked at the end point of adjuvant RT after prostatectomy. After controlling for tumor characteristics, which may also prompt the decision for adjuvant RT, men with PSMs had nearly 4 times the chance of undergoing adjuvant RT (odds ratio,
3.79; 95% CI, 3.63-3.96; \( P < .001 \). The overall cost to the US health care system was $52,068,000 for PSMs after RP, and the cost of RT for men with organ-confined disease, and potentially avoidable PSMs, was $9,372,240.\(^5\)

New technologies are now available that may help with surgical planning and training to help avoid PSMs at the time of RP. Multiparametric magnetic resonance imaging (MRI) has changed the paradigm in the diagnosis of prostate cancer. Previously, the diagnosis of prostate cancer relied on systematic biopsies of the prostate with known sampling errors leading to both undergrading and overgrading of disease. Multiparametric MRI has a high sensitivity for ruling out high-grade disease, and when lesions are seen, they can be targeted with fusion biopsies to detect more clinically significant cancers. Furthermore, multiparametric MRI also provides additional staging information so that adverse pathological features, such as extracapsular extension, may be detected before surgery. With this knowledge available before surgery, urologists have the opportunity to better plan nerve-sparing techniques or to anticipate areas of likely PSMs and when to consider resecting more tissue.

Using the data from multiparametric MRI on tumor location and pelvic anatomy has led to increased opportunities for surgical planning and education. By contouring lesions, accurate 3-dimensional models can be created for surgical planning to anticipate any areas of concern for PSM. These models have been translated into virtual reality, allowing surgeons to visualize tumors within the prostate using a virtual reality headset to better understand the tumor's location and proximity to critical structures, such as neurovascular bundles, the bladder neck, and the sphincter.\(^6\)

Even more-realistic training can be accomplished by using the multiparametric MRI data to create hydrogel 3-dimensional printed molds.\(^7\) Both tumor and normal anatomic details are created for the sole purpose of surgical education, allowing novice surgeons to train in the critical aspects of performing robotic-assisted RP with real-time feedback in terms of forces applied to neurovascular bundles during nerve-sparing procedures, anastomotic leak rates, and degree of PSMs.\(^7\) Novel surgical training platforms such as this present younger surgeons with an opportunity to gain more experience while not sacrificing current patient outcomes. The incorporation of the clinically relevant performance metrics of simulation in surgical training has the potential to lead to quicker learning curves and, ultimately, fewer PSMs.

Although a certain number of PSMs are unavoidable for men undergoing RP, Martini et al\(^6\) highlight the importance of preventing avoidable PSM in patients with organ-confined disease. These potentially avoidable PSMs can save millions of dollars per year for the US health care system, as well as added morbidity for patients undergoing both RP and adjuvant RT. Finally, new imaging and surgical training technology have the potential to warn urologists of potential areas of concern and lessen the learning curve of RP, leading to fewer PSMs in both organ-confined and non-organ-confined disease.


